

SECTION 411 – WARRANTED MICRO-SURFACING

411.01 Description

This work shall consist of furnishing materials and the construction of warranted micro-surfacing for rut filling and surface leveling applications in accordance with 105.03.

The Contractor shall be responsible for the warranted micro-surfacing for a period of three (3) years after the date all warranted micro-surfacing is completed and open to unrestricted traffic.

A Quality Control Plan in accordance with 411.16 shall be prepared and submitted to the Engineer at least 15 days prior to commencing micro-surfacing operations.

MATERIALS

411.02 Materials

Materials shall be in accordance with the following:

<i>Asphalt Emulsion</i>	<i>As Defined*</i>
<i>Coarse Aggregates – Class B or Higher **.....</i>	<i>904</i>
<i>Fine Aggregates***</i>	<i>904</i>
<i>Portland Cement, Type I.....</i>	<i>901.01(b)</i>
<i>Water.....</i>	<i>913.01</i>

** Polymer Modified Asphalt Emulsion shall be a quick-set, CSS-1h emulsion in accordance with AASHTO M 208 except the cement-mixing test is waived. The polymer material shall be milled or blended into the emulsion or blended into the emulsifier solution prior to the emulsification process. The minimum polymer solids content will be 3.0% based on the residual of the emulsion. Mix set additives shall be added as required to provide control of the quick-set properties. Additional requirements shall be in accordance with the following.*

<i>Characteristics</i>	<i>Test Method</i>	<i>Requirement</i>
<i>Residue (Note 1)</i>	<i>AASHTO T 59</i>	<i>62+</i>
<i>Softening Point, °F (°C)</i>	<i>AASHTO T 53</i>	<i>140+ (60+)</i>
<i>Viscosity @140°F (60°C)</i>	<i>AASHTO T 202</i>	<i>8000+</i>

NOTE 1. The temperature for this test shall be held below 180°F (82°C). The sample is oven evaporated on a glass plate at 77°F (25°C) for 24 h (forced draft oven). Material is then scraped from the plate with a razor blade tool.

*** The coarse aggregate angularity shall be a minimum of 95% in accordance with ASTM D 5821. The coarse aggregate for rut filling shall be limestone, dolomite, crushed gravel, sandstone, ACBF, or SF.*

**** The fine aggregate for micro-surface shall be limestone, dolomite, crushed gravel, sandstone, ACBF, or SF. The fine aggregate angularity shall be a minimum of 45 in accordance with AASHTO T 304 Method A. The clay content of the blended aggregate material from the fine and coarse aggregates shall meet a minimum sand equivalency of 50 in accordance with AASHTO T 176. The surface leveling application aggregate type shall be based on the ESAL category as follows:*

Fine Aggregate Type	Traffic ESALs		
	< 3,000,000	< 10,000,000	≥ 10,000,000
Air-Cooled Blast Furnace Slag	Yes	Yes	Yes
Steel Furnace Slag	Yes	Yes	Yes
Sandstone	Yes	Yes	Yes
Crushed Dolomite	Yes	Yes	Note 1
Polish Resistant Aggregates	Yes	Yes	Note 1
Crushed Stone	Yes	No	No
Gravel	Yes	No	No

NOTE 1. Polish resistant aggregate or crushed dolomite may be used when blended with ACBF or sandstone but cannot exceed 50% of the coarse aggregate by weight (mass), or cannot exceed 40% of the coarse aggregate by weight (mass) when blended with SF.

411.03 Design Mix Formula

The Contractor shall submit a Design Mix Formula, DMF, for the specific materials to be used on the project to the District Testing Engineer one week prior to use. The DMF shall state the following (all percentages are based on the dry weight of the aggregate):

- (a) source of each individual material
- (b) The aggregation gradation shall be in accordance with the following:

Sieve Size	Leveling	Rut Filling
3/8 in. (9.5 mm)	100	100
No. 4 (4.75 mm)	85-100	70-90
No. 8 (2.36 mm)	50-80	45-70
No. 16 (1.18 mm)	40-65	28-50
No. 30 (600 μ m)	25-45	19-34
No. 50 (300 μ m)	13-25	12-25
No. 100 (150 μ m)	7-18	7-18
No. 200 (75 μ m)	5-15	5-15

- (c) percentage of aggregate
- (d) percentage of mineral filler (minimum and maximum)
- (e) percentage of water (minimum and maximum)
- (f) percentage of mix set additives (if required)
- (g) percentage of polymer modified CSS-1h emulsified asphalt
- (h) state the quantitative effects of moisture content on the unit weight of the aggregate
- (i) results for the tests in the following:

<i>Characteristic</i>	<i>Test Method ISSA*</i>	<i>Requirement</i>
<i>Wet Cohesion</i> 30 Minutes, Min. (Set Time) 60 Minutes, Min. (Traffic)	<i>TB-139**</i>	12 kg-cm 20 kg-cm
<i>Wet Stripping, Min.</i>	<i>TB-114</i>	90%
<i>Wet Track Abrasion Loss</i> 60 Minutes Soak, Max.	<i>TB-100</i>	536 g/m ²
<i>Saturated Abrasion</i> <i>Compatibility, Max</i>	<i>TB-144</i>	3g loss
<i>Mix Time @ 77°F (25°C)</i>	<i>TB-113**</i>	<i>Controllable to 120 s</i>
<i>Mix Time @ 104°F (40°C)</i>	<i>TB-113**</i>	<i>Controllable to 35 s</i>

* International Slurry Surfacing Association

** The TB-139 (set time) and TB-113 (mix time) tests shall be checked at the highest temperature expected during construction. For the TB-113 test at 40°F (104°C), all ingredients and containers shall be preheated.

411.04 Pre-Paving Coordination

A pre-paving meeting between the Contractor and Engineer will be held on-site prior to beginning work. The agenda for this meeting will include as a minimum:

- (a) contractor's detailed work schedule
- (b) traffic control plan
- (c) calibration of equipment
- (d) Design Mix Formula/Job Mix Formula
- (e) inspection and evaluation of the condition and adequacy of equipment, including units for transport of materials
- (f) conflict resolution team members

CONSTRUCTION REQUIREMENTS

411.05 Preparation of Surfaces

The Contractor shall be responsible for all surface preparation including cleaning and the removal of all pavement markings and all other work that may affect the performance of warranted micro-surfacing. Drainage structures, monument boxes, water shut-offs, etc., shall be protected during application of material.

411.06 Opening to Traffic

The latex modifier shall be capable of producing an emulsified asphalt paving mixture that cures at a rate, which shall permit traffic on the pavement within one hour after application without damaging the pavement surface.

411.07 Finished Pavement Properties

The surface area shall not contain ripples greater than 1/8 in. (3 mm) measured by a 3 ft (1 m) straight edge. The surface shall not exhibit tear marks greater than 1/2 in. (13 mm) wide and 4 in. (100 mm) long, or a mark greater than 1 in. (25 mm) wide and 1 in. (25 mm) long.

The longitudinal construction joints and lane edges shall coincide with the proposed painted lane lines. Longitudinal joints shall be constructed with less than a

3 in. (75 mm) overlap on adjacent passes and no more than 1/4 in. (6 mm) overlap thickness measured with a 10 ft (3 m) straight edge in accordance with 409.03(f). If applicable, overlapping passes shall be on the uphill side to prevent ponding of water. Construct neat and uniform transverse joints with no more than a 1/8 in. (3 mm) difference in elevation across the joint as measured with a 10 ft (3 m) straight edge. The edge shall be neat and uniform with no more than 2 in. (50 mm) of horizontal variance in any 100 ft (30 m).

For multiple course applications, the surface of a lane shall not deviate more than 1/4 in. (6 mm) in the wheel path when measured transversely with a 10 ft (3 m) straight edge.

411.08 Warranty

Upon completion of all warranted micro-surfacing and opening to unrestricted traffic, the Warranty Bond shall be in effect for a total of three (3) years. The warranty bond shall be properly executed by a surety company satisfactory to the Department and be payable to the State of Indiana and submitted with the bid.

The warranty bond shall be an amount equal to 100% of the contract total for the warranted micro-surfacing excluding patching or other work included in the contract. The bond is intended to insure completion of required warranty work, including payments for all labor, equipment, materials and closure periods used to remediate any warranted distresses.

Upon the final acceptance of the project, the contractual obligations of the Contractor are satisfied as long as the micro-surfacing continues to meet or exceed the warranted values as defined herein.

All warranty work shall be accomplished in accordance with 411.10. At the end of the warranty period, the Contractor will be released from further warranty work or responsibility, provided all previous warranty work has been satisfactorily completed and approved by the Department.

411.09 Conflict Resolution Team

The scope of the Team includes all issues concerning the warranted pavement relative to the quality control plan, material selection, warranted pavement evaluations, distress indicators, remedial action, and remediation plans.

The Team will consist of two Contractor representatives, two Department (District and Central Office) representatives, and a fifth person mutually agreed upon by both the Department and the Contractor. All costs for the fifth person will be equally shared between the Department and the Contractor. The Team members will be identified in writing at the pre-construction meeting and will be knowledgeable in the terms and conditions of this warranty and the methods used in the measurement and calculation of pavement distress. Should any impasse develop, the Team will render a final recommendation to the Chief Engineer by a majority vote. Each member has an equal vote.

411.10 Warranty Work

During the warranty period, remedial work shall be performed at no cost to the Department and shall be based on the results of pavement distress surveys. Remedial work to be performed and materials to be used shall be a decision of the Contractor with approval of the Department. Prior to proceeding with any warranty work or monitoring, a Miscellaneous Permit shall be obtained from the Department.

During the warranty period, the Contractor may monitor the warranted micro-surfacing using non-destructive procedures. All proposed remedial action(s) shall be coordinated with the Department.

Coring, milling or other destructive procedures may not be performed by the Contractor, without prior consent of the Department. The Contractor will not be responsible for damages to the pavement as a result of coring, milling or other destructive procedures conducted by the Department.

The Contractor will have the first option to perform the remedial work. If, in the opinion of the Department, the problem requires immediate attention for safety of the traveling public and the Contractor cannot perform the remedial work within 24 hours, the Department has the option to have the remedial work performed by other forces. The Contractor shall be responsible to pay for all the costs incurred. Remedial work performed by other forces will not alter the requirements, responsibilities, or obligations of the warranty.

411.11 Pavement Distress Indicators, Thresholds, and Remedial Action

The Department will use the following pavement distress indicators throughout the warranty period:

- (a) Rutting – displacement of the micro-surfacing transversely to create a rut*
- (b) Delamination – physical separation of the micro-surfacing*
- (c) Raveling – wearing away of the micro-surfacing*
- (d) Skid Resistance – friction number*

The Department procedures for the measurement, evaluation, and reporting of pavement distresses for warranted micro-surface pavements are contained in 411.17.

The threshold values for each 300 ft (100 m) evaluation section are as follows:

<i>Rut Depth</i>	<i>6 mm</i>
<i>Delamination.....</i>	<i>0.1%</i>
<i>Raveling</i>	<i>0.1%</i>
<i>Friction Number.....</i>	<i>average 35, no value less than 25</i>

The Department will monitor the warranted micro-surfacing during the warranty period. A final condition survey will occur and the Contractor will be notified in writing of all required warranty work at least 90 days in advance of the expiration of the Warranty Bond.

If any of the threshold levels are met or exceeded, the Contractor shall recommend remedial action to the Department. After the remedial action is approved, the Contractor shall perform the remedial work.

Remedial action shall be performed on all segments of the project where the threshold levels are met or exceeded. If areas of warranted pavement, which are not within the measured area, are suspected of meeting or exceeding a threshold level, the Department will conduct a distress survey to see if a threshold level has been met or exceeded.

Remedial action shall be taken by October 1 of the same calendar year as the Contractor is notified that a threshold level has been met or exceeded. If, anytime during the warranty period, 30% or more of the project segment require, or have received remedial action, the entire project shall receive a remedial action as determined by the Contractor and the Department. If an impasse develops, the Team will make a final recommendation.

If remedial action work or elective/preventive action work performed by the Contractor necessitates a corrective action to the pavement markings, adjacent lane(s) or roadway shoulders, such corrective action to the pavement markings, adjacent lane(s), and shoulders shall be the responsibility of the Contractor.

Warranty requirements for all remediation work will be limited to the life of the original contract warranty.

If any of the threshold levels are met or exceeded and the Contractor does not agree to the pavement distress survey results or, the Department does not agree with the proposed remedial action, the Team will provide a recommendation within 30 days.

The Contractor will not be held responsible for distresses that are caused by factors beyond the control of the Contractor. For example, the Contractor will be relieved of the responsibility for the rutting threshold if the cause is not transverse movement of the micro-surfacing. The Contractor shall be responsible for materials and workmanship problems.

411.12 Elective/Preventive Action

Elective/preventive action will be the Contractor's option with the concurrence of the Department.

411.13 Department Maintenance

The Department will perform routine maintenance during the warranty period such as plowing, applying de-icing chemicals, repairs to safety appurtenances, pavement markings, mowing and sign maintenance. The Department, during the warranty period, will perform no routine pavement surface maintenance activities.

411.14 Method of Measurement

Warranted micro-surfacing will be measured by the square yard (square meter). The width of the pavement course will be the width placed. The length will be measured along the centerline of each roadway or ramp.

411.15 Basis of Payment

Warranted micro-surfacing will be paid for at the contract unit price per square yard (square meter) of micro-surface, warranted complete in place.

Payment will be made under:

Pay Item**Pay Unit Symbol**

Micro-Surfacing, Warranted.....SYD (m2)

The cost of furnishing materials, equipment, labor, and tack coat, if required, and all incidentals shall be included in the cost of micro-surfacing, warranted.

411.16 Quality Control Plan for Warranted Micro-Surfacing

The Contractor shall produce a mixture that will be in compliance with the DMF and the quality control tolerances. The methods described in this section shall be used by the Contractor to measure compliance. The Contractor shall maintain all quality control documentation and make a copy available to the Engineer upon request or at completion of the contract.

(a) Fine Aggregate

The Contractor shall sample from the project stockpile and test for gradation at a rate of one per 500 t (500 Mg) of aggregate used, or a minimum of one per day of mixture production. The quality control tolerances from the DMF are as follows:

<i>Sieve Size</i>	<i>Tolerance</i>
<i>No. 4 (4.75 mm)</i>	<i>± 5.0%</i>
<i>No. 8 (2.36 mm)</i>	<i>± 5.0%</i>
<i>No. 16 (1.18 mm)</i>	<i>± 5.0%</i>
<i>No. 30 (600 µm)</i>	<i>± 5.0%</i>
<i>No. 50 (300 µm)</i>	<i>± 4.0%</i>
<i>No. 100 (150 µm)</i>	<i>± 3.0%</i>
<i>No. 200 (75 µm)</i>	<i>± 3.0%</i>

(b) Sand Equivalent Test

ASTM D 2419 shall be performed with each applied aggregate gradation. Quality control tolerance is ± 7% of the DMF as established in the mix design.

(c) Asphalt Content

The Contractor shall calculate the percent asphalt content of the mixture from the equipment counter readings randomly, a minimum of three times a day. The quality control single test tolerance is ± 0.5% and the average daily asphalt content is ± 0.2% from the DMF.

(d) Application Rate

The Contractor shall calculate the yield of the course being placed from the equipment counter readings randomly, a minimum of three times a day. The quality control tolerance from the specified application rate is ± 1.8 lb/syd (± 1 kg/m²).

(e) Documentation

The Contractor shall maintain a daily report, providing the following information.

1. *Control section*
2. *Job number*
3. *Route*
4. *Date*
5. *Air temperature*
6. *Control settings (calibration values, unit weight of emulsion, percent residue of emulsion)*
7. *Beginning and ending intervals*
8. *Counter readings (and beginning, and ending, and total)*
9. *Length, width, total area, aggregate quantity, emulsion quantity*
10. *Percent of each material, percent of asphalt cement, application rate, combined application rate*
11. *Contractor's authorized signature*
12. *Aggregate gradations*
13. *Aggregate delivery tickets*
14. *Asphalt emulsion bill of lading*
15. *Sand equivalent value*

A statement that all material certification, production test reports, quality control charts, test equipment certifications and calibrations, and all other material and/or design or production related records shall be maintained for a period to include the terms of the warranty. The records, either electronic and/or hard copies, shall be maintained in a readily accessible location for access by the Department at any time. Upon completion of the placement, and the opening of the warranted micro-surfacing to traffic, a copy of all records shall be provided to the Department.

411.17 Measurement, Evaluation And Reporting Of Pavement Distress For Warranted Micro-surfacing

The Department will perform routine evaluations of the warranted pavement during the warranty period. During the warranty period, the Contractor has the right, with Department concurrence, to independently review the condition of the warranted pavements for their use and information.

(a) Measurement

The Department will be using the Friction and the Highway Performance Monitoring System (HPMS) programs to evaluate the warranted pavement distress indicators.

1. The Office of Research oversees the friction Testing Program. Warranted pavement friction program will be in accordance with Section 5.3 of the program, dated December 2003 or later.

2. The Planning Division oversees the Highway Performance Monitoring System program.

(b) Evaluation

The Department will evaluate the condition of the pavements on the Interstate system annually and bi-annually for non-Interstate routes for the identified pavement performance indicators. During the warranty period, exclusive of the last year, the evaluations will be conducted on driving lanes throughout the length of the project except for friction testing which will be conducted on the driving and passing lane or middle lane or No. 2 lane for multi-lane facilities. The final year evaluations will be conducted in every lane throughout the length of the project for all pavement performance indicators.

(c) Friction

Friction testing on the warranted micro-surfacing contract section will be by the use of a Locked Wheel Trailer as defined by ASTM E 274 and a smooth tire in accordance with ASTM E 524. Friction tests will be conducted in all lanes at each reference post and at the halfway point between the reference posts. A minimum of 11 tests will be conducted. If the number of tests is less than 11, additional tests will be taken at the quarter point between the reference post and the halfway point. The number of locations will depend on the length of the project. The friction values of each site per lane will be determined.

(d) Rutting

The Department will rate rutting at the time of routine condition survey for the warranted micro-surface.

Sensors on the van will measure the rut depth of each wheel path in an approximation of the measurement obtained using the commonly accepted four-foot straight-edge method. The readings shall be continuous along the length of the segment. The average rut depth of both wheel paths for each 300 ft (100 m) segment will be determined.

The rut measurement will be made with the van using at least three/five readings across the pavement surface. These readings will be taken at the approximate right wheel path center, center of the lane, left wheel path center. The sensors measure the relative height from the sensor to the surface and calculate the rut as the relative differences of the readings.

(e) General Pavement Distresses

The Department will monitor pavement warranty performance for acceptance. Delamination, ravelling, and rutting are measured the entire length of the warranty contract section, but only in the specific lanes. Friction is not sampled continuously in the sections. If any values exceed the thresholds, more detailed testing and inspection may be conducted to determine the extent and limits of the deficiency. All areas outside the tested lanes or sample sections observed to show deficiencies may also be tested and used to determine the pavement warranty acceptability and to verify the uniformity of the quality of the project.

(f) Reporting

1. Friction Testing Evaluation

The Office of Research will prepare a summary report of the results of the testing and submit the results to the Manager, Office of Pavement Engineering.

2. Rutting Testing Evaluation

The Manager, Office of Pavement Engineering will prepare a summary report of the results of the testing.

3. Performance Pavement Distress Indicators Evaluation

The Office of Pavement Engineering will compile the results and determine the acceptability of the sections as compared to the threshold values listed in 411.11. A recommendation will be submitted to the State Construction Engineer for final acceptance/remediation. Final acceptance will not be recommended prior to receipt of the Warranted Project Quality Control Information in accordance with 411.16.

411.18. Final Warranty Acceptance

The State Construction Engineer will review the recommendation and issue a Final Warranty Acceptance letter.
